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In an aspect of at least one embodiment of the present invention, there is provided a method of determining the initial position of the moving part of a planar motor in a lithographic projection apparatus.

See the attached Appendix for the changes made to effect the above paragraphs.

IN THE CLAIMS:

Please enter the following amended claims:

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1. (Amended) A lithographic projection apparatus comprising:

a radiation system to provide a projection beam of radiation;

a support structure to support patterning structure, the patterning structure serves to pattern the projection beam according to a desired pattern;

a substrate table to hold a substrate;

a positioning system to position at least one of said support structure and said substrate table, said positioning system comprising a stator and a translator, one of said stator and said translator comprising a periodic magnet structure and the other of said stator and said translator comprising a plurality of coils, said plurality of coils being configured to receive a movement signal to induce movement of said translator in more than one degree of freedom, said plurality of coils being further configured to receive an oscillating signal to induce vibrations of said translator, said vibrations having an amplitude less than the period of said periodic magnet structure;

a projection system to project the patterned beam onto a target portion of said substrate; and

a vibration measurer to measure vibrations of said translator in more than one degree of freedom and to determine a phase relationship between said translator and said stator on the basis of said measured vibrations.

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~~10~~ 20. (Amended) A positioning system to position an object, said positioning system comprising:

a stator and a translator, one of said stator and said translator comprising a periodic magnet structure and the other of said stator and said translator comprising a plurality of coils, said plurality of coils being configured to receive a movement signal to induce movement of said translator in more than one degree of freedom, said plurality of coils being further configured to receive an oscillating signal to induce vibrations of said translator, said vibrations having an amplitude less than the period of said periodic magnet structure; and

a vibration measurer to measure said vibrations of said translator in more than one degree of freedom and determine a phase relationship between said translator and said stator on the basis of said measured vibrations.

A4 cont.

~~11~~ 25. (Amended) A device manufacturing method using a lithographic projection apparatus, the lithographic apparatus including a positioning system to position at least one of a support structure to support patterning structure and a substrate table, said positioning system comprising a stator and a translator, one of said stator and said translator comprising a periodic magnet structure and the other of said stator and said translator comprising a plurality of coils configured to receive a movement signal to induce movement of said translator in more than one degree of freedom, the method comprising:

providing a substrate that is at least partially covered by a layer of radiation-sensitive material;

providing a projection beam of radiation using a radiation system;

using patterning structure to endow the projection beam with a pattern in its cross-section;

projecting the patterned beam of radiation onto a target portion of the layer of radiation-sensitive material;

applying to a plurality of said coils an oscillating signal sufficient to cause vibrations of said translator in more than one degree of freedom, said vibrations having an amplitude less than the period of said periodic magnet structure;

measuring said vibrations of said translator in more than one degree of freedom; and

determining a phase relationship between said translator and said stator on the basis of said measured vibrations.

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~~12~~. (Amended) A device manufactured according to a method using a lithographic projection apparatus, the lithographic apparatus including a positioning system to position at least one of a support structure to support patterning structure and a substrate table, said positioning system comprising a stator and a translator, one of said stator and said translator comprising a periodic magnet structure and the other of said stator and said translator comprising a plurality of coils configured to receive a movement signal to induce movement of said translator in more than one degree of freedom, the method comprising:

A4 cont.

providing a substrate that is at least partially covered by a layer of radiation-sensitive material;

providing a projection beam of radiation using a radiation system;

using patterning structure to endow the projection beam with a pattern in its cross-section;

projecting the patterned beam of radiation onto a target portion of the layer of radiation-sensitive material;

applying to a plurality of said coils an oscillating signal sufficient to cause vibrations of said translator in more than one degree of freedom, said vibrations having an amplitude less than the period of said periodic magnet structure;

measuring said vibrations of said translator in more than one degree of freedom; and

determining a phase relationship between said translator and said stator on the basis of said measured vibrations.

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~~13.~~ 34 (Amended) A computer program to determine a phase relationship of a stator and a translator in a lithographic projection apparatus, the lithographic projection apparatus including a positioning system to position at least one of a substrate table and a support structure to support patterning structure, said positioning system comprising a stator and a translator, one of said stator and said translator comprising a periodic magnet structure and the other of said stator and said translator comprising a plurality of coils configured to receive a movement signal to induce movement of said translator in more than one degree of freedom, the computer program comprising program code to, when executed on a computer, perform the method of:

applying to a plurality of said coils an oscillating signal sufficient to cause vibrations of said translator in more than one degree of freedom, said vibrations having an amplitude less than the period of said periodic magnet structure;

measuring said vibrations of said translator in more than one degree of freedom; and

determining a phase relationship between said translator and said stator on the basis of said measured vibrations.

See the attached Appendix for the changes made to effect the above claims.

Please add the following new claims:

~~14.~~ 10 (New) The lithographic projection apparatus according to claim 1, wherein said vibration measurer is configured to measure vibrations of said translator in at least two orthogonal directions.

~~15.~~ 11 (New) The lithographic projection apparatus according to claim 1, wherein said plurality of coils is configured to induce vibrations of said translator in at least two orthogonal directions.

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12 ~~16.~~ (New) The lithographic projection apparatus according to claim 1, wherein said plurality of coils is configured to induce movement of said translator in at least three degrees of freedom.

13 ~~17.~~ (New) The lithographic projection apparatus according to claim 1, wherein the plurality of coils includes coils arranged in a first direction and coils arranged in a second direction different than the first direction, and

wherein the plurality of coils is configured to receive the oscillating signal only through coils arranged in the first direction.

A5 cont.

14 ~~18.~~ (New) The lithographic projection apparatus according to claim 1, wherein the plurality of coils includes coils arranged in a first direction and coils arranged in a second direction different than the first direction, and

wherein the plurality of coils is configured to receive the oscillating signal through fewer than all of the coils arranged in the first direction.

15 ~~19.~~ (New) The lithographic projection apparatus according to claim 1, wherein each of the plurality of coils has a forward conductor and a return conductor, and

wherein at least one of the plurality of coils is configured to have a return conductor in a different magnetic field polarity than the corresponding forward conductor.

16 ~~20.~~ (New) The lithographic projection apparatus according to claim 1, wherein each of the plurality of coils has a forward conductor and a return conductor, and

wherein at least one of the plurality of coils is configured to have a spacing between a forward conductor and the corresponding return conductor at least substantially equal to a distance between a first parallel line connecting the centers of adjacent magnets of the

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periodic magnet structure of a first orientation and a second parallel line connecting the centers of adjacent magnets of the periodic magnet structure of a second orientation opposite to the first orientation.

17 ~~21~~. (New) The lithographic projection apparatus according to claim 1, wherein each of the plurality of coils has a forward conductor and a return conductor, and

wherein at least one among the plurality of coils has a forward conductor whose length is substantially equal to an even multiple of a distance between a first parallel line connecting the centers of adjacent magnets of the periodic magnet structure of a first orientation and a second parallel line connecting the centers of adjacent magnets of the periodic magnet structure of a second orientation opposite to the first orientation.

A5 Cont.

18 ~~22~~. (New) The lithographic projection apparatus according to claim 1, wherein each of the plurality of coils has a forward conductor and a return conductor, and

wherein the plurality of coils includes a first coil oriented parallel to a second coil, and

wherein the forward conductor of the first coil is closer than the return conductor of the second coil to the forward conductor of the second coil.

19 ~~23~~. (New) The lithographic projection apparatus according to claim 1, wherein the periodic magnet structure is periodic in each of at least two orthogonal directions.

21 ~~24~~. (New) The positioning system according to claim ~~10,~~ 20 wherein said vibration measurer is configured to measure an amplitude and a direction of said vibrations.

22 ~~25~~. (New) The positioning system according to claim ~~10~~ 20, wherein said plurality of coils is configured to induce movement of said translator in at least three degrees of freedom.

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~~26~~ 23. (New) The positioning system according to claim ~~10~~ 20, wherein the plurality of coils includes coils arranged in a first direction and coils arranged in a second direction different than the first direction, and

wherein the plurality of coils is configured to receive the oscillating signal only through coils arranged in the first direction.

~~27~~ 24. (New) The positioning system according to claim ~~10~~ 20, wherein each of the plurality of coils has a forward conductor and a return conductor, and

wherein at least one of the plurality of coils is configured to have a spacing between a forward conductor and the corresponding return conductor at least equal to a distance between a first parallel line connecting the centers of adjacent magnets of the periodic magnet structure of a first orientation and a second parallel line connecting the centers of adjacent magnets of the periodic magnet structure of a second orientation opposite to the first orientation.

~~28~~ 26. (New) The device manufacturing method according to claim ~~11~~ 25, wherein measuring said vibrations of said translator includes measuring an amplitude and a direction of said vibrations.

~~29~~ 27. (New) The device manufacturing method according to claim ~~11~~ 25, wherein measuring said vibrations of said translator includes measuring a phase of said vibrations relative to said oscillating signal.

~~30~~ 28. (New) The device manufacturing method according to claim ~~11~~ 25, wherein measuring said vibrations of said translator includes measuring said vibrations in a least two orthogonal directions.

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29 ~~31~~. (New) The device manufacturing method according to claim 25 ~~11~~, wherein the plurality of coils includes coils arranged in a first direction and coils arranged in a second direction different than the first direction, and

wherein applying an oscillating signal includes applying the oscillating signal only to coils arranged in the first direction.

30 ~~32~~. (New) The device manufacturing method according to claim 25 ~~11~~, wherein the plurality of coils includes coils arranged in a first direction and coils arranged in a second direction different than the first direction, and

A5 cont

wherein applying an oscillating signal includes applying the oscillating signal to fewer than all of the coils arranged in the first direction.

32 ~~33~~. (New) The device according to claim 31 ~~12~~, wherein measuring said vibrations of said translator includes measuring an amplitude and a direction of said vibrations.

33 ~~34~~. (New) The device according to claim 31 ~~12~~, wherein the plurality of coils includes coils arranged in a first direction and coils arranged in a second direction different than the first direction, and

wherein applying an oscillating signal includes applying the oscillating signal only to coils arranged in the first direction.

35. (New) The computer program according to claim 34 ~~13~~, wherein measuring said vibrations of said translator includes measuring an amplitude and a direction of said vibrations.

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